

**REMARKS**

Claims 1, 3 through 8 and 10 are pending in this Application. Claims 1, 6, 7, 9, 10, and 11 have been amended, and claims 2, 9, 11 and 12 cancelled. Care has been exercised to avoid the introduction of new matter. Adequate descriptive support for the present Amendment should be apparent throughout the originally filed disclosure noting, for example, that limitations from claim 2 have been incorporated into claim 1, dependent claims 7, 9 and 11 appropriately amended, and editorial changes have been made in claims 6 and 10 to address formalistic issues. Applicants submit that the present Amendment does not generate any new matter issue.

**Claim Objections.**

The Examiner objected to claims 6 and 10, identifying perceived informalities. In response claims 6 and 10 have been amended to address the informalities identified by the Examiner, thereby overcoming the stated bases for the claim objections. Accordingly, withdrawal of the claim objections is solicited. The Examiner's perspicacity is appreciated.

**Claim Objection.**

The Examiner objected to claim 12 under 37 C.F.R. § 1.75, asserting it is a substantial duplicate of claim 6. In response, claim 12 has been cancelled, thereby obviating the objection.

**Claims 1 through 3 and 7 through 11 were rejected under the second paragraph of 35 U.S.C. § 112.**

In the statement of rejection the Examiner asserted that the claims are incomplete for omitting essential structural cooperative relationships of elements. This rejection is traversed.

In response, Applicants initially regret an error identified by the Examiner. Specifically, the Examiner correctly noted that “X” is not defined as the pore size in the specification. Rather, “X” represents the size and particles employed for determining the trapping ratio in actual filtration.

Based upon the above correction, a relationship between the variables X, Y, and L, the plot of 10 points, and a connection thereof with the structural properties in the membrane are described below for clarification.

(a) With respect to outer side pressed filtration

As described in paragraph [0019], an object of the present invention is to prevent a decrease in a flow rate with the passage of time without clogging pores of a porous material with solid particles in filtration of a solution with high turbidity, to easily recover filtration performance by back washing and maintain high filtration performance over a long period of time, and to improve durability of a porous membrane against outside and inside pressures and bending. Therefore, the present invention satisfies the following requirements (1) to (4):

(1) A porous multilayered hollow fiber is adapted for outer side pressed filtration of solid liquid separation treatment, the filtration being performed from the outer surface side thereof toward the internal surface side.

(2) The hollow fiber comprises a supporting layer of an expanded porous polytetrafluoroethylene (PTFE) tube, and a filtration layer including a porous expanded polytetrafluoroethylene (PTFE) sheet formed by expanding a resin uniaxially or biaxially apart from the supporting layer, the filtration layer being adhered to the outer surface of the supporting

layer disposed on the inner surface side to form a multilayered body, and pores in the supporting layer three-dimensionally communicating with pores in the filtration layer.

(3) Pores surrounded by fibrous frameworks in the filtration layer are smaller than those of the supporting layer.

(4) The mean of the maximum fibril length (L) of the fibrous frameworks surrounding each pore in the outer surface of the filtration layer disposed on the outer surface side is designed such that (X) and (Y) fall within the range defined by plotting the following 10 points on the XY plane, where (X) is a particle diameter of particles captured when the particle trapping ratio is equal to or more than 90% in the case where the filtration is done under an elevated pressure of 0.1 MPa, and (Y) is a value designed as RFL obtained by dividing (L) by (X), that is,  $(Y = L/X)$ :  $(X, Y) = (0.055, 2), (1, 1.5), (2, 1), (5, 0.5), (10, 0.3), (10, 4), (5, 6), (2, 10), (1, 15), (0.055, 25)$ .

As to requirement (1), a porous multilayered hollow fiber is adapted for outer side pressed filtration of solid liquid separation treatment, the filtration being performed from the outer surface side thereof toward the internal surface side. Since the multilayered hollow fiber is used for outer side pressed filtration, clogging does not occur in the inner surface in filtration of a solution with high turbidity.

The present invention does not involve pre-filtration with a layer having large pores, and then filtration performed by an inner layer having small pores to capture particles by the whole of the filtration layers. However, as described in requirement (3), in the present invention, a solution is filtered with the supporting layer having large pores after filtration through the outer filtration layer with small pores, without using a pre-filter.

In addition, as a subject matter defined in requirement (4), particles are rebounded from the outer surface of the outer filtration layer to inhibit the entrance of particles into the pores, thereby preventing clogging and maintaining the penetration of a liquid.

Requirement (4) is an important basic feature of the present invention. Specifically, it was found that a factor for clogging of pores with solid particles greatly depends on the maximum length of many pores surrounded by fibrous frameworks and present in the outermost filtration surface (outermost surface) of the filtration layer. On the basis of this finding, particles are captured and cut off by the outermost filtration surface of the filtration layer without entering the filtration layer. Therefore, consideration is given to the maximum length of many pores present in the outer surface of the filtration layer and surrounded by fibrous frameworks. Namely, the maximum length of pores of the filtration layer is specified for the particle size of captured particles so that 90% or more of captured particles are rebounded from the outer surface of the filtration layer to inhibit the entrance into pores, thereby preventing clogging and maintaining the penetration of a liquid.

(b) The “Relationship between variables X, Y, and L and the plot of 10 points” and “Connection thereof with structural properties of a membrane”

As specified in requirement (2), the filtration layer includes a porous expanded PTFE sheet formed by expanding a resin uniaxially or biaxially, and the PTFE expanded porous sheet has a fibrous fine structure in which flexible fibers are connected in a three-dimensional network and contains many pores surrounded by fibrous frameworks. Since the sheet is expanded uniaxially or biaxially, the pores surrounded by fibrous frameworks in the uniaxially expanded sheet are mostly slit-shaped pores elongated in a direction and the pores in the biaxially

expanded sheet are mostly network, rhombic, elliptic, or circular pores as shown in the attached Reference Document 1 (Exhibit A) showing SEM images of the outer surfaces of filtration layers. In addition, the shape of pores varies depending on the draw ratio and processing method used. In the attached Reference Document 2 (Exhibit B), as seen from the photographs of the outer surfaces of filtration layers according to the present invention, pores have various shapes.

Although pores surrounded by fibrous frameworks have various shapes as described above, the maximum length of pores is specified because there are slit-shaped elongated pores, but the mean pore size or pore ratio of pores present in the filtration layer is not specified.

The reason for defining the maximum length of pores is that PTFE resin fibers are elastic, and thus when slit-like elongated pores are clogged with particles, the pores are changed to rounded pores due to elasticity, thereby failing to simply define the mean pore size. Furthermore, in definition of the pore ratio, the pore ratio may be determined to be constant regardless of pore sizes. However, when particles to be filtered off have unspecified shapes, the definition is meaningless.

As a result of repeated intensive experiments, it was found that the definition of the maximum length of pores has the highest correlation to the particle trapping ratio in filtration. Therefore, the maximum length of pores is defined.

As described in paragraph [0022] of the written description of the specification, the term "maximum length of pores" represents the maximum crossing length of spaces constituting pores, i.e., the maximum value of a distance between two points on the periphery of each pore formed by a resin portion and fibers connected thereto. The length corresponds to S shown in Reference Figure 1. The mean of the maximum length S is L. The maximum length S of each pore is calculated by hand calculation or an image processing soft using an elongated SEM

image of the outer surface. It has been well known that a length or area is calculated by hand calculation or an image processing soft using a SEM image. This method is a commonly used method. Reference Document 3 (Exhibit C) shows an example of actual measurement of a mean maximum length using a SEM image.

As to requirement (4), the reason for specifying (X) and (Y) so that (X) and (Y) fall within the range defined by plotting the above-described 10 points on the XY plane is based on the finding of a range in which the trapping ratio is 90% or more, the range being found by repeated vast experiments in which the particle diameter (X) of captured particles and the value (Y) obtained by dividing the mean maximum length (L) by (X) were variously changed.

Filtration is generally performed with a filtration layer with a certain thickness so that particles are captured by pores formed in a three-dimensional network in the whole layer including the thickness of the filtration layer, and thus there is the problem of causing clogging due to the gradual accumulation of particles in pores with the passage of time, thereby decreasing the flow rate of the whole filtration layer. However, in the porous multilayered hollow fiber for outer side pressed filtration of this invention, the filtration layer is provided as an outer layer, and the mean maximum length (L) of fibrous frameworks surrounding many pores present in the outer surface of the filtration layer is designed as described above. Namely, the maximum length (L) is designed to a small value so that in a stationary state after an initial stage of solid-liquid separation treatment, solid particles to be separated can be easily removed by back washing or the like without being irreversibly captured by the pores. In other words, the maximum length (L) is designed so that in a stationary state after the flow rate is decreased in the initial stage of solid-liquid separation treatment under optimum filtration pressure and back washing pressure,

particles are not substantially irreversibly captured by the pores in the filtration layer and the supporting layer. Therefore, it is possible to rebound 90% or more of solid particles from the outer surface of the filtration layer, prevent clogging, and maintain the penetration of a liquid.

Furthermore, in the present invention, as specified in the requirement (2), both the filtration layer and the supporting layer are made of porous expanded PTFE. PTFE has excellent durability against inside and outside pressures and bending and excellent chemical resistance, and the property of being capable of increasing filtration lifetime. PTFE is also advantageous in that formability is excellent, expansion is easily made, and the size and shape of pores can easily be controlled. In closely bonding together a PTFE tube on the inner side and a PTFE sheet on the outer side to form a unified body, the surface of the tube on the inner side is preferably subjected to physical treatment such as flame treatment, laser irradiation, plasma irradiation, coating of a fluorine-based dispersion, or the like, or chemical treatment to form irregularities in the surface, as described in paragraphs [0040] to [0043]. Such treatment can be performed on PTFE.

As described above, the porous multilayered hollow fiber for filtration of the present invention satisfies the requirements (1) to (4) and thus can significantly decrease the occurrence of clogging in a stationary state after the initial stage of general filtration. As a result, it is possible to significantly decrease the frequency of maintenance works such as back washing and achieve the specified effect of improving durability.

Based upon the foregoing, Applicants submit that one having ordinary skill in the art would have no difficulty understanding the scope of the claimed invention, particularly when

reasonably interpreted in light of and consistent with the written description of the specification.

*Miles Laboratories, Inc. v. Shandon, Inc.*, 997 F.2d 870, 27 USPQ2d 1123 (Fed. Cir. 1993).

Applicants, therefore, submit that the imposed rejection of claims 1 through 3 and 7 through 11 under the second paragraph of 35 U.S.C. § 112 is not legally viable and, hence, solicit withdrawal thereof.

**Claims 1 through 3 and 6 through 12 were rejected under 35 U.S.C. § 103 for obviousness predicated upon JP-3221095-B (JP '095) in view of JP 2000-107758 (JP '758) or JP 63-028406 (JP '406).**

In the statement of the rejection the Examiner maintained the conclusion that one having ordinary skill in the art would have found the claimed subject matter as a whole obvious within the meaning of 35 U.S.C. § 103 based upon the combined disclosures of JP '095 and either JP '758 or JP '406. This rejection is traversed.

There are significant differences between the claimed inventions and the applied prior art that undermine the obviousness conclusion under 35 U.S.C. § 103. This is because even if the applied references are combined as suggested by the Examiner, and Applicants do not agree that the requisite fact-based motivation has been established, the claimed inventions would not result.

*Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 USPQ2d 1434 (Fed. Cir. 1988).

Moreover, each of the applied references are directed to completely different concepts from that encompassed by the claimed invention. Accordingly, it cannot be said that one having ordinary skill in the art would have been realistically motivated to combine these references to arrive at the claimed invention.

Specifically, JP '095 relates to a fiber in which an inside surface with a smaller pore size is effective for filtration from the inside toward the outside because of little clogging. JP '095 employs a two-layer structure having different pore sizes. However, in the present invention, the "pore size" is defined by the particle inhibition ability of the whole membrane of the filtration layer, and this further advanced to focus attention on the importance of "filtration surface", i.e., on the fiber length of the surface. This is a novel concept which is neither disclosed or suggested in JP '095. Indeed, JP '095 does not suggest that RFL is effective for clogging.

JP '758 discloses, in paragraph [0033], that in a condensed water treatment method, the maximum pore size of a membrane is 0.05 to 1.0  $\mu\text{m}$ . In production example 1 described in paragraph [0060] in which the pore size is 1.0  $\mu\text{m}$  and the fractioned particle diameter is 0.23  $\mu\text{m}$ , Y is about 4.4. This value falls in the range specified in the requirement (4) of this invention.

In paragraph [0033] of JP '758, it is disclosed that the maximum pore size determined by a bubble point method is preferably 0.05 to 1.0  $\mu\text{m}$ . The bubble point method is a general method for evaluating a pore size. One having ordinary skill in the art would have understood that a pore size indicated by a filter manufacturer is **different from** the maximum pore size calculated by a bubble point test, and that the pore size calculated by the bubble point method should **not** be actually used for removal of fine particles in a liquid, because the pore size calculated by the bubble point method is **larger** than the actual size.

In the present invention, as specified in the requirement (4), the mean maximum length of pores surrounded by fibrous frameworks of the outer surface of the filtration layer serving as a filtration surface is defined by a correlation to the aim of captured particles for determining the

pore size, and is thus the idea of the pore size is different from that measured by the bubble point method in JP '758. Therefore, the pore size measured by the bubble point method described in paragraph [0033] is basically different in index from the mean maximum length (L) specified in the requirement (4) of this invention and is different in constitution from the mean maximum length (L) specified in the requirement (4).

In addition, with respect to the pore size of each layer, in JP '758 and publication 2, it is described in paragraph [0022] that in a compact layer, the mean microfibril length is preferably 0.2 to 5  $\mu\text{m}$ , and in a supporting layer, the microfibril length is preferably 0.5 to 10  $\mu\text{m}$ . Furthermore, in paragraph [0014], it is described that the ratio  $D_b/D_a$  of the mean distance  $D_b$  between microfibril bundles in the supporting layer to the mean distance  $D_a$  between microfibril bundles in the compact layer after coating is preferably in the range of 1.3 to 4.0.

JP '758 does not specify that in two porous layers including outside and inside layers, the outside layer has a smaller pore size, but the inside layer has a larger pore size. Therefore, the present invention based on a different technical idea, which is not suggested by the description in paragraph [0088] of JP '758.

Furthermore, JP '758 relates to a condensed water treatment method for a nuclear power plant or the like. Condensed water is very clean and contains fine particles to be captured, and thus only a single component such as iron clad or the like is captured. Therefore, condensed water which is clean water is treated, and thus the filtration performance using an outer layer having a larger pore size and an inner layer having a smaller pore size is not so different from that in a reverse structure. Therefore, the JP '758 includes a constitution opposite to that of this invention, i.e., an arrangement including an inner layer with a smaller pore size and an outer layer with a larger pore size.

As pointed out above, JP '758 does not disclose the important requirement (4) of the present invention, and is different from the present invention in that JP '758 relates to condensed water treatment. However, the present invention can be applied to a solution with high turbidity.

JP '406 relates to the problem in which particles (effective component) contained in a solution to be treated can be passed to the penetration side without being captured by a membrane, but is not basically aimed at capturing particles contained in a liquid to be treated. Therefore, JP '406 does not relate to an improvement in a method for contact between a filtration surface and particles as in this invention, but relates to an improvement in a method for passing particles without capturing by a membrane. Also, unlike in the present invention, an improvement method is based on a different idea that the porous structure of an oblong base membrane is changed using a second polymer. Thus, JP '406 proposes an optimum invention for passing plasma components of a fine size together with a filtrate, but not simple filtration. Also, with respect to the structural characteristic, JP '406 discloses the necessity of structural control over the entire thickness in the three-dimension directions, but not the outermost filtration surface of this invention. In order to realize this control, two different polymers are used, and thus the purpose of the technique is completely different from this invention.

Based upon the foregoing it should be apparent that each of the applied references are completely different from the present invention. Ergo, the combination of these references as proposed by the Examiner would not yield the claimed invention. Moreover, because of the dramatic difference between the applied prior art and the present invention it cannot be said that one having ordinary skill in the art would have been realistically impelled to combine these

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references in such a manner as to arrive at the claimed invention. *Panduit Corp. v. Dennison Mfg. Co.*, 774 F.2d 1082, 227 USPQ 337 (Fed. Cir. 1985).

Applicants, therefore, submit that the imposed rejection of claims 1 through 3 and 6 through 12 under 35 U.S.C. § 103 for obviousness predicated upon JP '095 in view of JP '758 or JP '406 is not legally viable and, hence, solicit withdrawal thereof..

Based upon the foregoing it should be apparent that the imposed objections and rejections have been overcome, and that all pending claims are in condition for immediate allowance. Favorable consideration is, therefore, solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP

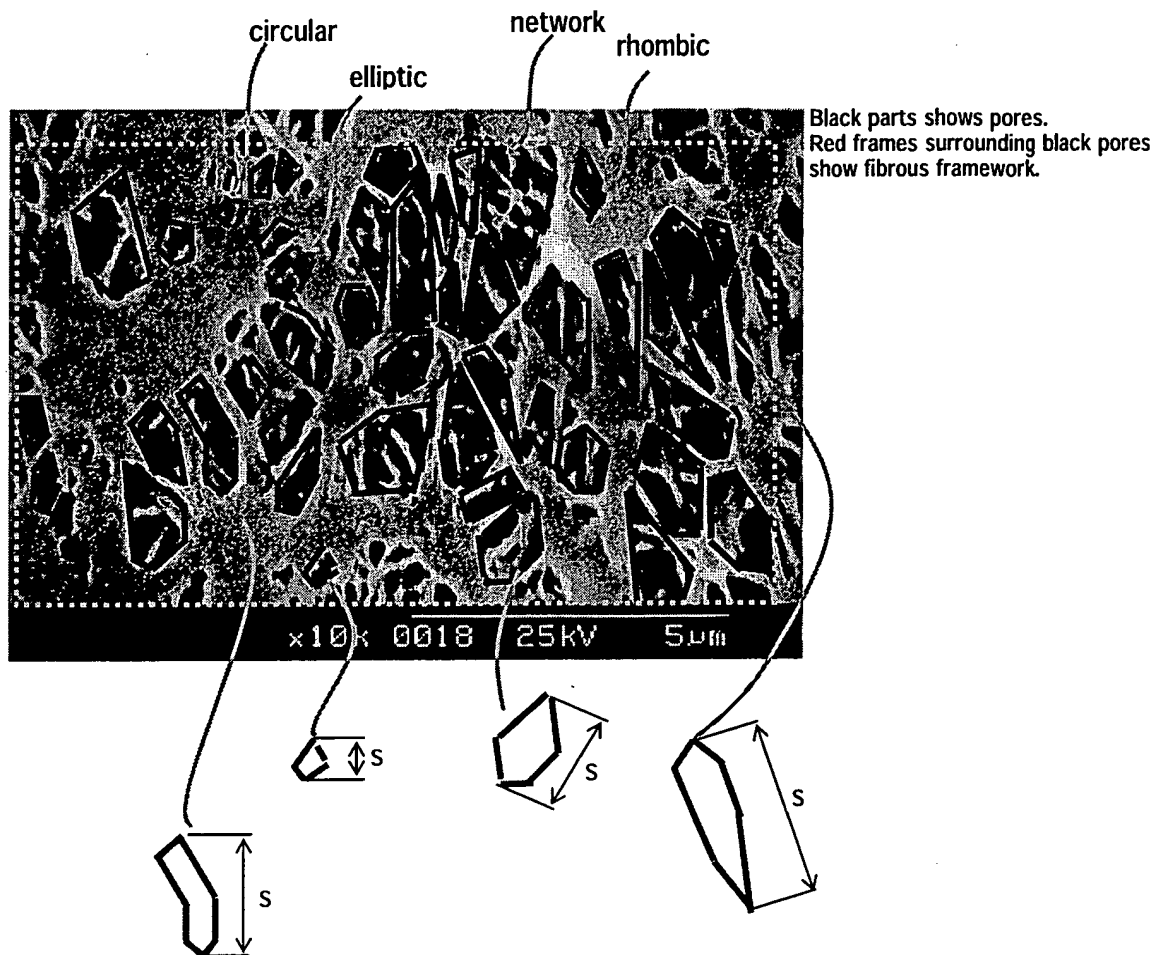


Arthur J. Steiner  
Registration No. 26,106

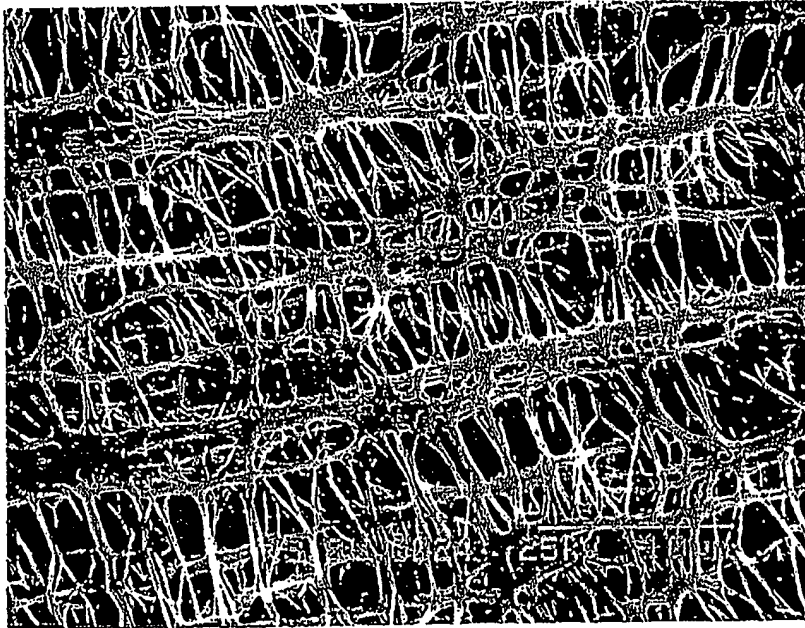
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Washington, DC 20005-3096  
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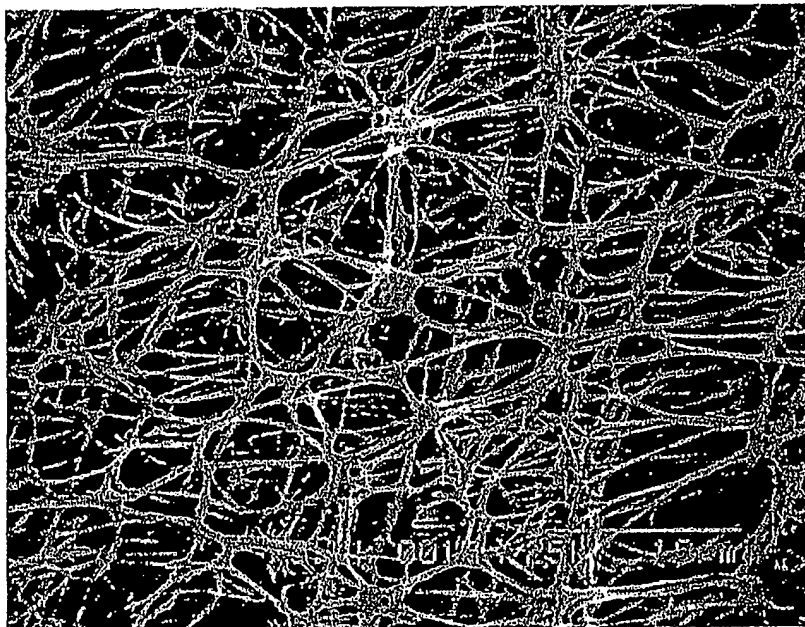
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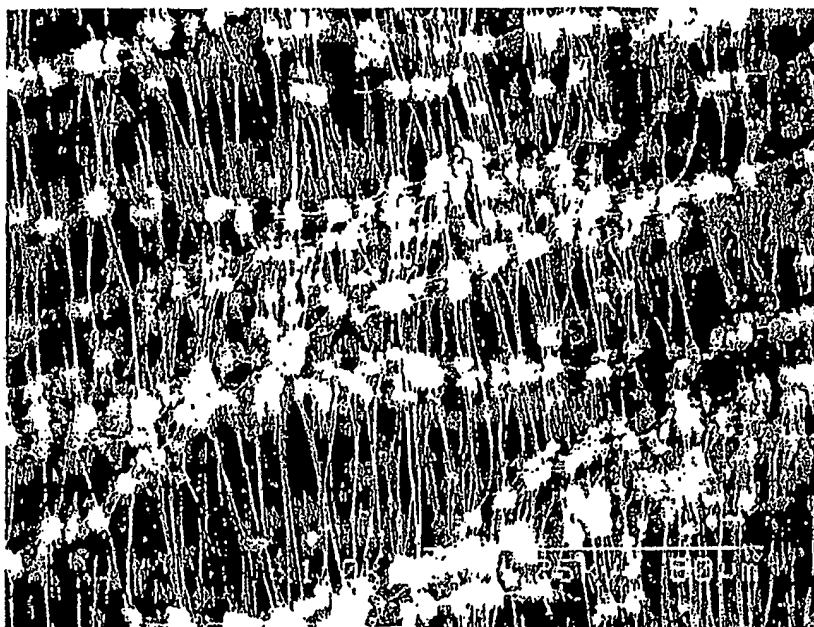


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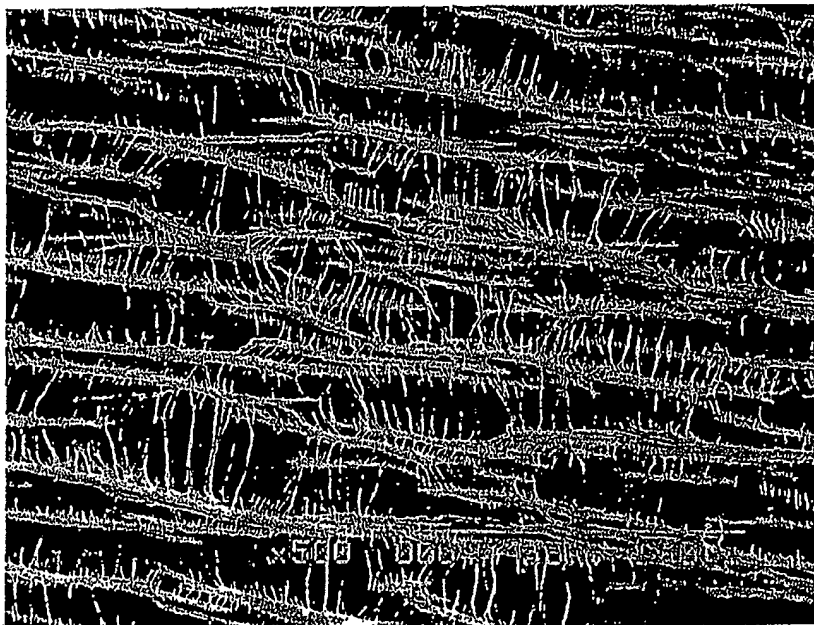
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surface

X 1000

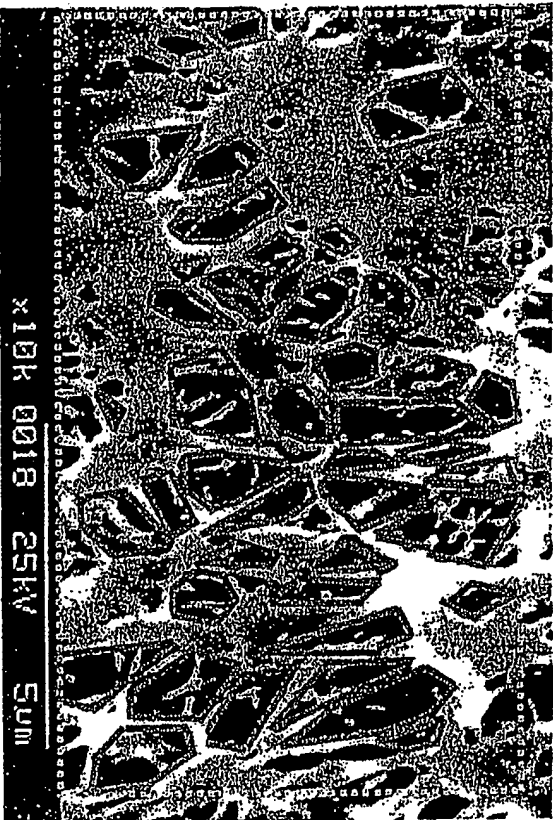


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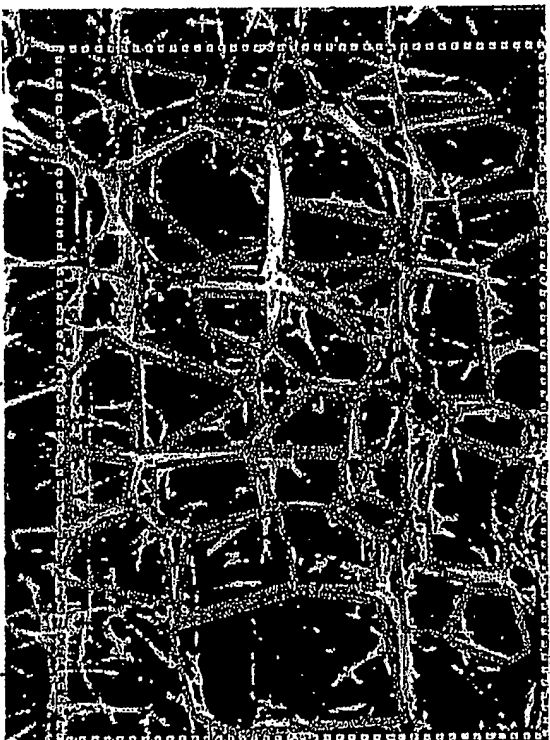
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REFERENCE 3

EXAMPLE OF MEASURING THE MAXIMUM FIBRIL LENGTH



the mean of maximum fibril length 1.3  $\mu\text{m}$



the mean of maximum fibril length 4.1  $\mu\text{m}$